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ALGEBRAIC TESTS FOR FUNCTIONAL CONTROLLABILITY OF FUNCTIONAL DI--ETC(U)
MAY 82 R TRIGGIANI AFOSR-77-3338

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FINAL SCIENTIFIC REPORT ON

A.F.O.S.R. Grant 77-3338

Project Title: Algebraic Tests for Functional Controllability of Functional Differential Equation Systems

Principal Investigator: R. Triggiani, Mathematics Department
Iowa State University
Ames, Iowa 50011

Grant duration: June 1, 1976 through December 31, 1981, through Iowa State University

The scientific investigation carried out under the AFOSR Grant in question has evolved, during its five year duration, into two phases: Phase one (roughly, from June 1, 1976 through 1977) and phase two (roughly from 1977 throughout the end, December 31, 1981).

Phase one. This initial phase refers to my research work carried out jointly with Dr. Andrzej Manitius (Centre de Recherches Mathematiques, Universite de Montreal). It focused primarily on function space controllability properties (of interest in tracking problems) and in stabilizability properties (with arbitrarily preassigned exponential decay) for linear retarded control systems having delays in their dynamics. These efforts have given rise to publications [1],[2],[3].. Announcements of our research results were made, as they were obtained, at various conferences, including: (i) 1976 John Hopkins conference on Information and Systems; (ii) 1976 Workshops at Catalina Island (Los Angeles), organized by the University of California, Los Angeles, Department of Systems Science; (iii) First International Symposium on Dynamical Systems, 1976 University of Florida, Gainesville; etc. These results have inspired other researchers who have extended them to neutral systems.

Phase two. In the 1978-79 Proposal, of this Grant, ample ground and evidence was provided that delay differential equations of

ITEM #20, CONT.: out that it is particularly within the context of semigroup theory that this link is brought up to light. Thus, it was asserted, the semigroup theory appeared to be capable of providing an altogether unexpected unifying approach to all these classes of apparently diverse dynamical systems. It was therefore natural to enlarge the original investigation as to include boundary control systems. Publications arising from this work are listed in the report.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
The first phase of work supported under the grant focused primarily on function space controllability properties, of interest in tracking problems, and in stabilizability properties, with arbitrarily preassigned exponential decay, for linear retarded control systems having delays in their dynamics. The second phase of work ample ground and evidence was provided that delay differential equations of retarded and neutral types on the one hand and distributed parameter systems of parabolic and hyperbolic types on the other hand are, somewhat surprisingly, closely related. It was pointed (CONTINUED)

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retarded and neutral types on the one hand and distributed parameter systems of parabolic and hyperbolic types on the other hand are (somewhat surprisingly) closely related. It was pointed out that it is particularly within the context of semigroup theory that this link is brought up to light. Thus, it was asserted, the semigroup theory appeared to be capable of providing an altogether unexpected unifying approach to all these classes of apparently diverse dynamical systems. It was therefore natural to enlarge the original investigation as to include boundary control systems. The scientific publications that have since resulted under this grant attest to the correctness of the proposed direction of investigation: see publications [4] through [14]. Phase two of this grant was carried out either independently by myself, or else jointly with a Post-Doctoral Fellow (Dr. I. Lasiecka). A brief sketch of the contents of these works follows. Papers [4] and [9] develop an effective input-solution formula to study boundary input hyperbolic equations, along with a study of regularity properties of their solutions. Papers [6], [8],[10],[11],[12],[13] study various types of boundary feedback stabizations problems for both parabolic and hyperbolic distributed systems, where the boundary feedback is of an easily implementable form. Papers [7] and [14] focus on well-posedness questions of such boundary feedback systems. There is a consistent approach throughout these boundary control papers, which is based on input - solution formulas. These are a sort of "variation of parameter" formulas and are rooted in cosine operator theory in the hyperbolic case [4,9], and in semigroup theory in the parabolic case.

Roberto Triggiani

Publications originated under the AFOSR

Grant-77-3338

[1] A. Manitius and R. Triggiani, Function space controllability of linear retarded systems: a derivation from abstract operator conditions, SIAM J, Control & Optimiz. vol 16, N.4, July 1978, pp 599-645.

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[3] A. Manitius and R. Triggiani, New Results on Functional Controllability for Time-delay systems, Proceedings 1976 Conference on information and Systems,John Hopkins University.

[4] R. Triggiani, A cosine operator approach to modeling boundary inputs problems for hyperbolic systems. Proceedings of 8th IFIP Conference on Optimization Techniques, University of Würzburg, West Germany, September 1977, Springer-Verlag Lecture Notes on Control Sciences, N.6 (1978), pp. 380-390.

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[7] R. Triggiani, Well-posedness and regularity of boundary feedback parabolic systems, J. Differ. Equat., 36, 347-362 (1980).

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[9] I. Lasiecka and R. Triggiani, A cosine operator approach to modeling $L_2[0,T;L_2(\Gamma)]$ boundary input hyperbolic equations Applied Math and Optimization, 7, (1981), pp. 35-83.

[10] I. Lasiecka and R. Triggiani, Hyperbolic equations with Dirichlet boundary feedback via position vector: regularity and almost periodic stabilization, Part I, Applied Mathematics and Optimization, 8 (1981), pp. 1-37.

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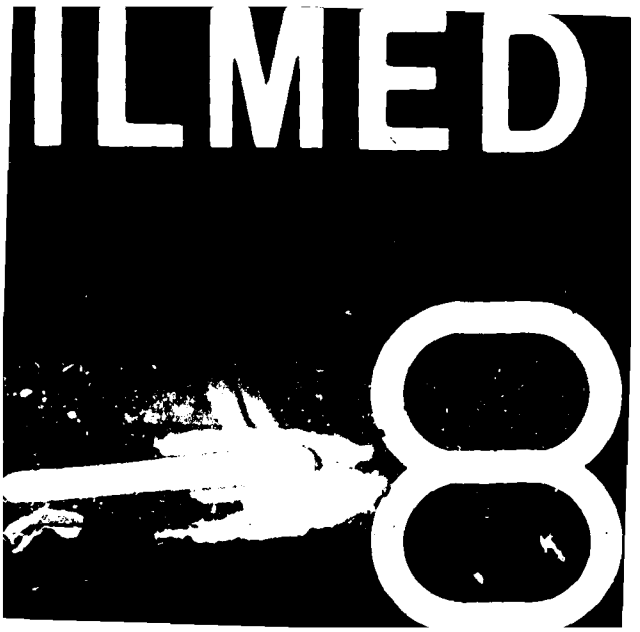
[13] I. Lasiecka and R. Triggiani, Stabilization and Structural Assignment of Dirichlet boundary feedback parabolic equations, submitted to SIAM J. Control & Optimiz.

[14] I. Lasiecka and R. Triggiani, Feedback semigroup and cosine operators for boundary feedback parabolic and hyperbolic equations, Journal of Differential Equations, to appear.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